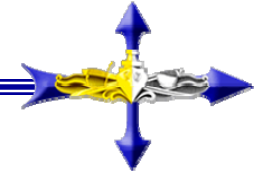


75th MORSS 712CD Cover Page

12-14 June 2007, at US Naval Academy, Annapolis, MD



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Name of Principal Author and all other author(s):

David E. Gilbert

Principal Author's Organization and address: Commander, Surface Warfare Development Group
2200 Amphibious Drive
Norfolk VA 23521-2896

Original title on 712 A/B:

"Summary of SHAREM Exercise Lessons Learned"

(Please use the same title listed on MORSS Form 712 A/B. If the title was changed please list the revised title below.) Revised title:

Title on PowerPoint slide is "SHAREM – 37 Years of Lessons Learned"

Presented in: WG(s) # 33 CG _____, Special Session _____,

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Report Documentation Page				Form Approved OMB No. 0704-0188	
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*Commander,
Surface Warfare Development Group
(SWDG-21)*



*“SHAREM – 37 Years of
Lessons Learned”*

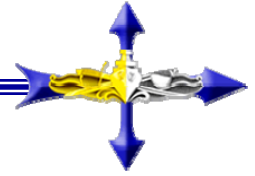
David E. Gilbert – SWDG TD



SHAREM

37 Years of Lessons Learned

Surface Warfare Center of Excellence

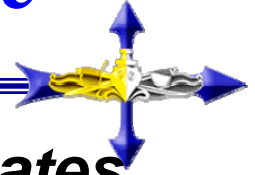


- ☐ ***Background/Overview***
- ☐ ***Improved-SHAREM Process***
- ☐ ***Metrics***
- ☐ ***Lessons Learned***



Naval Warfare Center of Excellence

Surface Warfare Center of Excellence

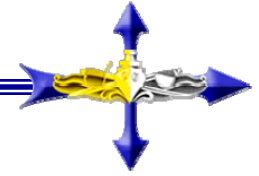


- ***Develops, improves, tests, validates, and evaluates fleet doctrine and platform- and mission-specific TTP***
- ***Secondary roles in enhancing the capability of the Navy forces to operate effectively in unilateral, joint, and coalition operations***
- ***Additional Duties Include:***
 - ✓ *Responsibilities in the areas of operational test and evaluation,*
 - ✓ *Research and development,*
 - ✓ *Experimentation,*
 - ✓ *Modeling and simulation,*
 - ✓ *War gaming,*
 - ✓ *Requirements definition,*
 - ✓ *Joint and allied doctrine and TTP development.*



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SWDG-21



The Readiness Effectiveness Measuring (REM) Program(s)

Technical ...

How well does it work?



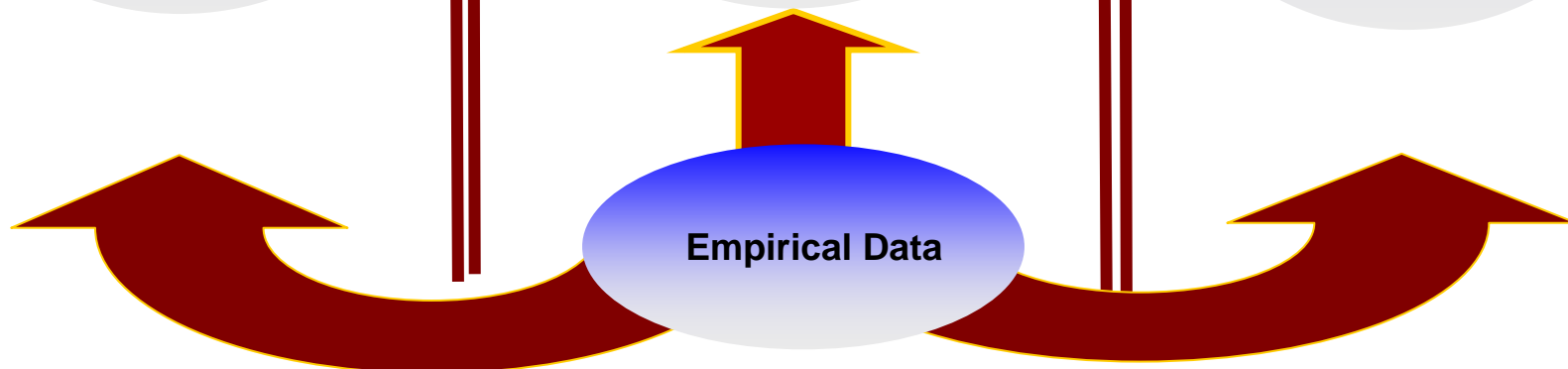
Training ...

Do we know how to operate it ?



Tactical ...

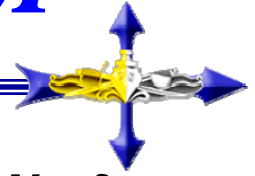
How is it employed against the threat ?





High Level Assessment vs. REM

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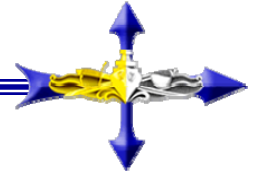
- **High Level Assessments conducted at the integrated or Warfare Commander & above level**
 - ❑ *Primarily ascertains Staff's ability to effectively plan & implement a campaign at the operational & tactical level*
 - ❑ *Planning considerations are driven by expected unit performance*
 - ❑ *Asset allocation driven by performance trade-offs*
- **REM analysis conducted at the unit level down to the individual unit, sensor package & weapon**
 - ❑ *Empirical data collected provides critical performance feedback to tactical & operational planners*
 - ❑ *Allows individual units to ascertain innate capabilities and adjust operational plans at the tactical level*
 - ❑ *Identifies performance levels and sets operational capabilities*
 - ❑ *Provides optimal asset mix for various tactical considerations*
 - ❑ *Identifies potential game changer systems or weapons*
 - ❑ *Identifies and provides capability gap non-materiel solutions*



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REM Program

Where is the Focus?



*Fundamentally unit performance
determines IPCLEs & Gaps*

- **REM programs analyze unit performance**
 - ☐ Sensor performance
 - ☐ Weapon effectiveness
 - ☐ Human factors
 - ☐ Overall system effectiveness
 - ☐ Causality factors
- **Integrated assessment is the Monday morning Coaches debate**
 - ☐ What could have been done differently?
 - ☐ How well did we execute the plan?
- **Individual units make the plays on the battlefield – not the staff**
 - ☐ Unit performance determines where gaps exist
 - ☐ Gaps determine integrated priority capability lists

Find – Fix – Track – Target – Engage – Assess

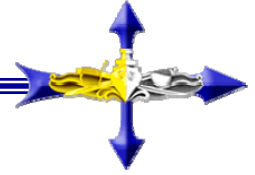
All Unit Level Functions – Regardless of Warfare Area



REM Program

What does it Measure?

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- **Find** – *sensor capabilities against known targets*
 - ❑ *Structured events establish optimal performance – “as good as it gets” – involves ability to correctly classify*
 - ❑ *Exceptions: National Sensors and other programs*
- **Fix** – *ability of sensor system to localize TOIs*
 - ❑ *Function of sensor’s collective errors in range and bearing*
- **Track** – *ability of sensor system to maintain contact and establish course and speed information*
- **Target** – *ability of sensor-weapon system pair to achieve targeting quality solution*
- **Engage** – *sensor-weapon system ability to consummate the kill chain*
- **Assess** – *ability of sensor-weapon system pair to ascertain engagement success*
 - ❑ *May be some staff functions in this area*

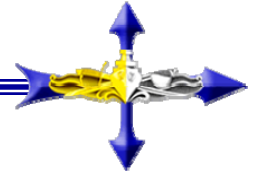
Generally Broader in Scope ... Than pure experimentation



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REM Program

What does it Provide?



➤ **Acquisition Community**

- ☐ Provides legacy system performance feedback – identifies potential upgrade points
- ☐ Early evaluation of developmental systems
- ☐ Identifies human factor issues
- ☐ Operational capability vs. engineering assessment

➤ **Research & Development Community**

- ☐ Focuses R&D efforts in capability gap areas
- ☐ Venue for evaluating developmental efforts

➤ **Training Community**

- ☐ At-Sea Operational Feedback loop
- ☐ Data for FST-U implementation
- ☐ Identifies NCEA requirements

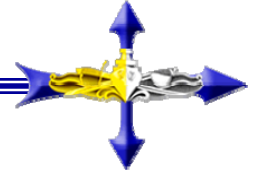
Real World – Operational Environment – Representative Threats
Systems Tactically Employed – ROC & POE Validation – Fleet Operators



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REM Program

What does it Provide?



➤ **Warfighter**

- ☐ *Hot Wash-up Rapid feedback on exercise results – 90% solution*
- ☐ *What happened – may not have answers to why it happened*
- ☐ *Current capability assessment in areas of immediate interest*
- ☐ *Feedback for MCO planning*

➤ **Doctrine & Tactics Community**

- ☐ *Tactical development, validation, verification & refinement venue*
- ☐ *Identifies and develops non-materiel solutions to mitigate or resolve current capability gaps*

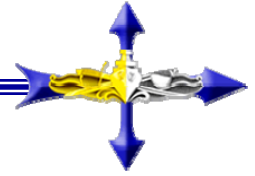
Real World – Operational Environment – Representative Threats
Tactically Focused – Areas of Interest - What it takes to win...



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REM Program

What makes It Effective?

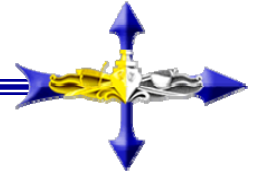


- **Annual Goal End State established**
- **Objectives agreed upon up & down Chain of Command**
 - ❑ *Prioritized to achieve End State Goals*
- **Analysis Plan developed that supports objectives**
- **Exercise/Experimentation Time & Assets Allocation**
 - *Determined by assessing the objective data collection requirements*
- **Post-ex Analysis – Levels of Granularity**
 - ❑ *Participant Feedback*
 - ❑ *Determine progress towards end-state goals*
 - ❑ *Assess key performance parameters*
 - ❑ *Update trend analysis*
- **Review, Revise & Refine Annual Plan to attain Goals**
 - ❑ *Compare to hypotheses – make corrections as necessary*
 - ❑ *Feedback to Sponsor & Stakeholders*



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SHAREM History



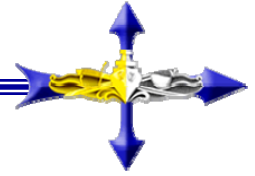
- ***Established by CNO in 1969 to quantitatively assess surface ship ASW performance (circa UPTIDE Experimentation)***
 - ❑ *COMSURFWARDEVGRU: Executive Agent*
- ***Assess surface ship and ASW force performance***
- ***Identify fleet deficiencies and shortfalls***
- ***Informs Fleet Investment Strategy - identifying requirements and guiding procurement process***
- ***Provide test bed to evaluate new technologies, systems, and prototypes***
- ***Maintain database on ASW sensor & weapon performance***
- ***Site specific areas of interest shift in 1992 – more tactically relevant/representative – response to C5F request***

Ships' ASW Readiness, Effectiveness Measuring (SHAREM) Program



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SHAREM Evolution

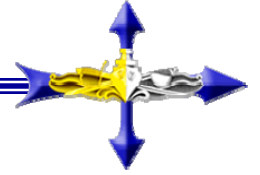


- ***Originally purely an engineering evaluation***
 - ❑ *ASW systems were groomed*
 - ❑ *Performance evaluated against established acceptance metrics*
- ***Gradual shift to tactical evaluation***
 - ❑ *Exercises limited, primarily, to East Coast assets*
 - ❑ *Typically regarded as goal-post to goal-post events*
- ***Area of interest shift in early 1990s***
 - ❑ *Conduct exercises in forward deployed, tactically significant areas*
 - ❑ *Participants on deployment*
 - ❑ *Representative threats and/or threat tactics*
 - ❑ *Assess current state expected performance*
 - ❑ *Combination structured and freeplay evaluations*



Think Again...

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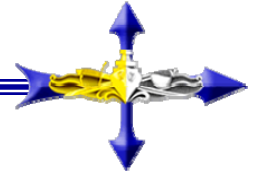




SHAREM

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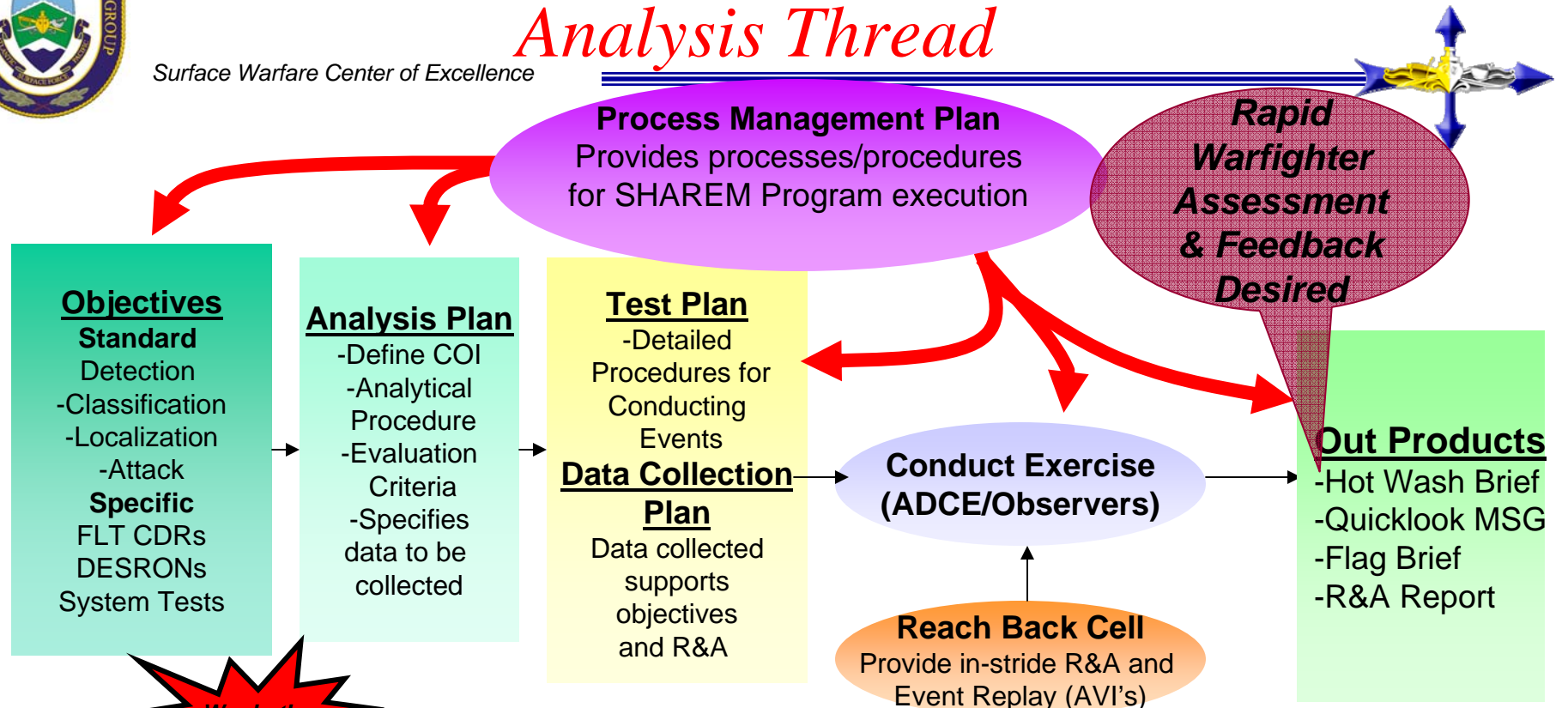
- ✓ ***Background/Overview***
- ✦ ***Improved-SHAREM Process***
- ***Metrics***
- ***Lessons Learned***



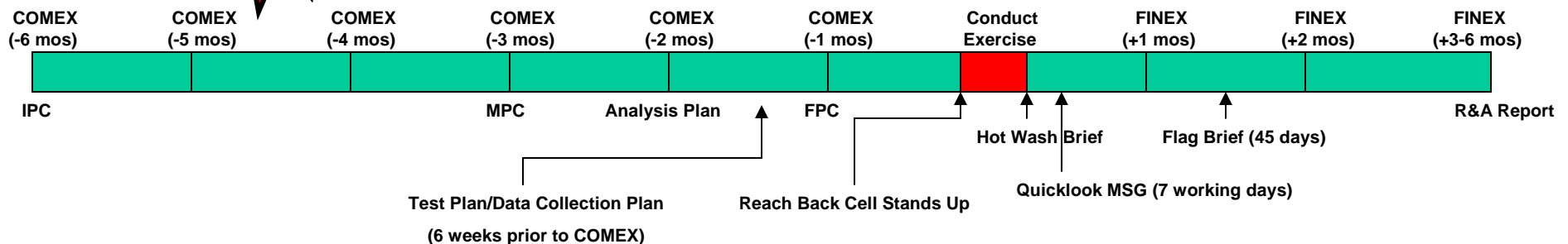
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Improved SHAREM

Analysis Thread



Improved SHAREM Timeline

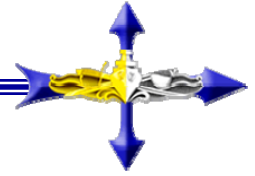




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I-SHAREM

Program Specific Goals



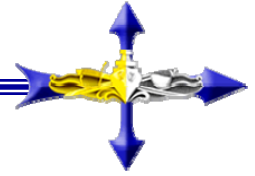
- ***Provide a tactical development and validation vehicle***
 - ☐ *Realistic, tactically significant environments*
 - ☐ *Multi - platform USW force: ships, aircraft, submarines, SURTASS*
 - ☐ *Coalition partner involvement*
 - ☐ *Ground truth track reconstruction*
 - ☐ *Extensive analysis & meteorological impact assessment*
 - ☐ *Validated results for training, doctrine, and programmatic decisions*
 - ☐ *Identify and provide non-materiel solutions*
 - ☐ *Mitigate current gaps and optimize fielded systems with TTP*
 - ☐ *Address Warfighter concerns and provide rapid feedback*
- ***Sensor & Weapon System performance assessment***
 - ☐ *Employed in tactical areas of interest*
 - ☐ *Representative threats & tactics (or emulations thereof)*
 - ☐ *Performance across the 'kill chain'*
 - ☐ *Identify materiel performance shortfalls*



I-SHAREM

Measurements & Evaluations

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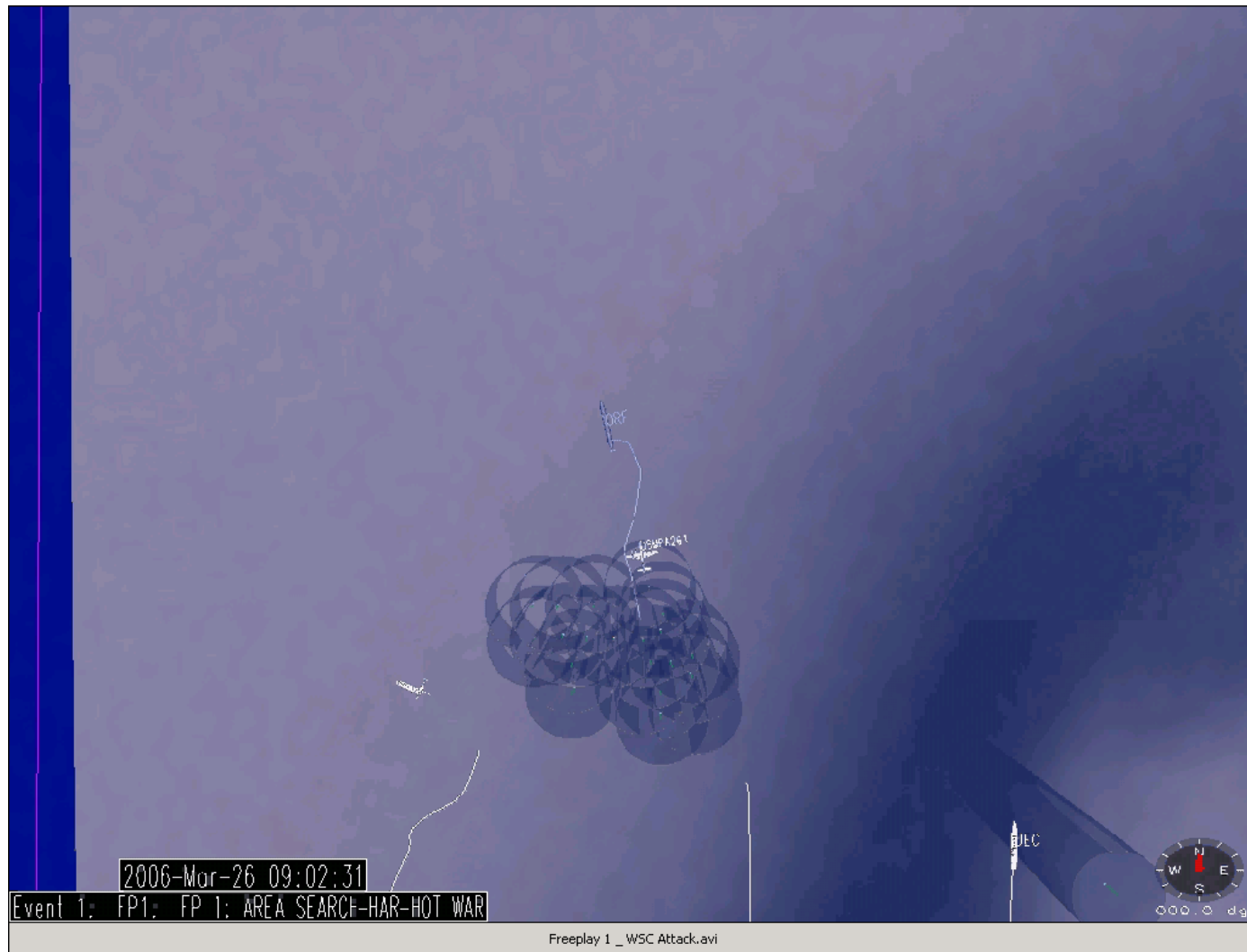
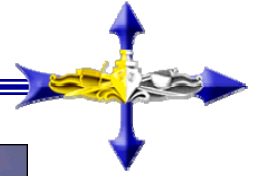
- ***Acoustic & non-acoustic sensor detection & classification effectiveness***
- ***ASW localization procedures & tactics; accuracy & timeliness***
- ***ASW attack procedures, weapons & tactics***
- ***ASW C4I and data fusion in Task Force operations***
- ***Acoustic and non-acoustic vulnerability to detection and attack by (diesel) submarines***
- ***Ability of ASW forces to exploit the environment***



I-SHAREM

Hot-Wash Products

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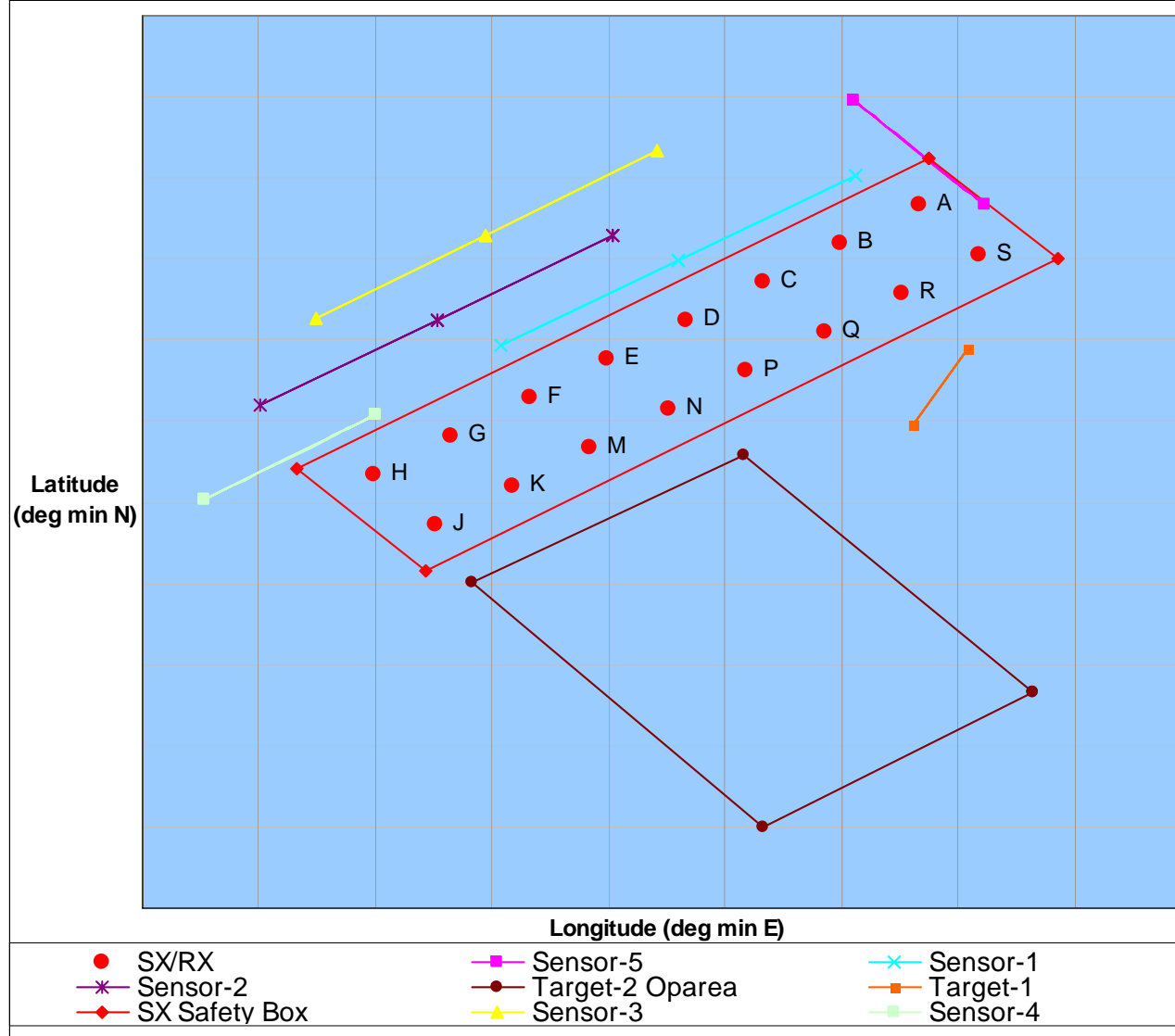
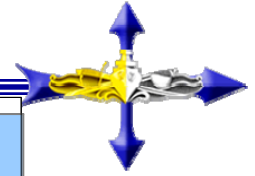




Multi-Static ASW

Physics Experiment/Test

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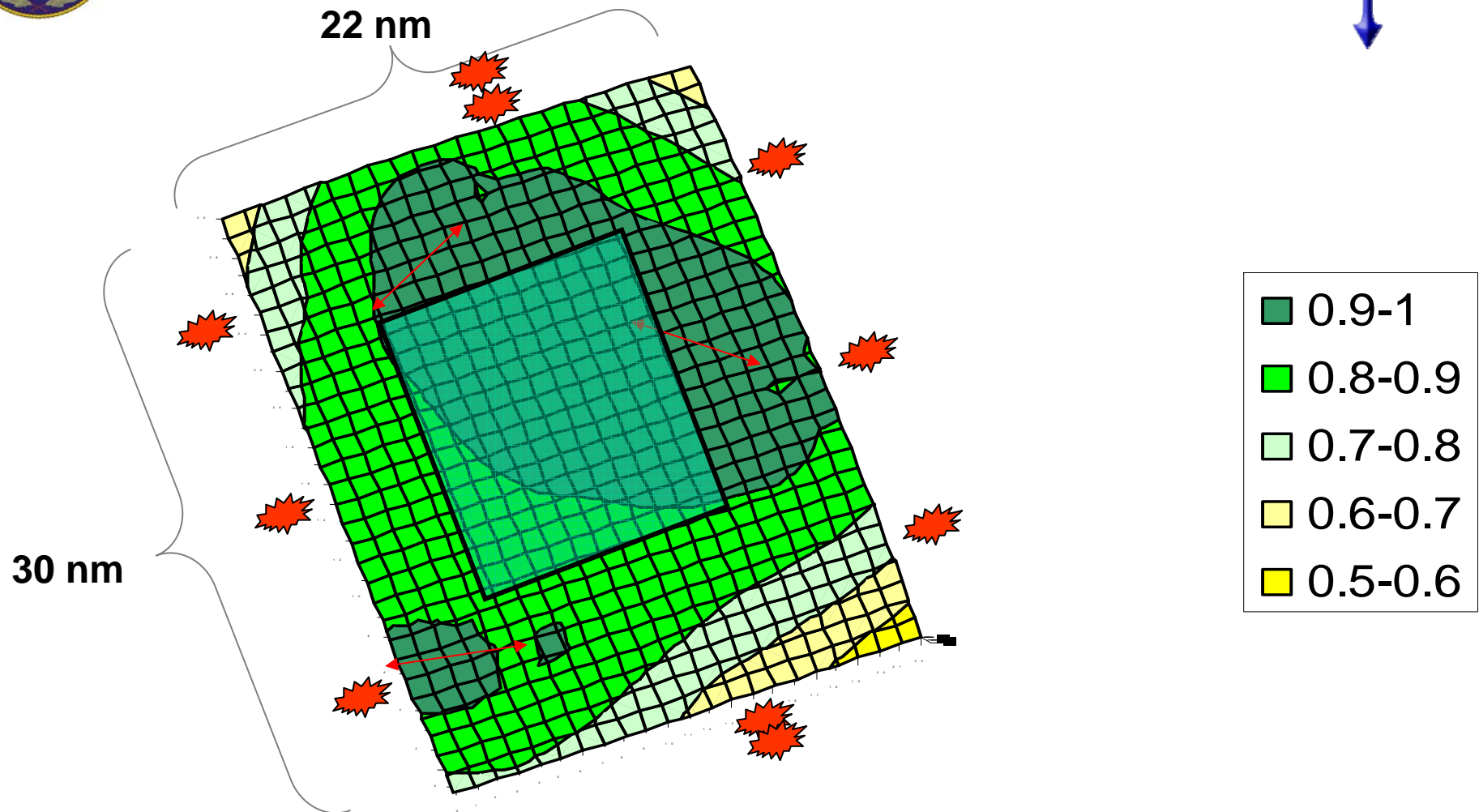
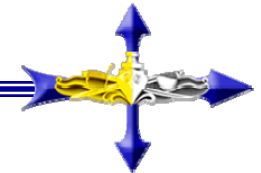




Multi-Static ASW

Tactical Experiment

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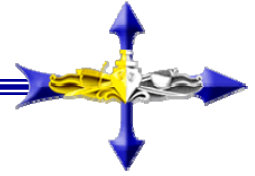




SHAREM

37 Years of Lessons Learned

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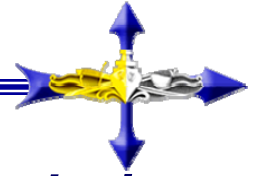


- ✓ ***Background/Overview***
- ✓ ***Improved-SHAREM Process***
- ✦ ***Metrics***
- ***Lessons Learned***



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Improved SHAREM Analysis



Best metrics are independent of platform actions or exercise design

Probability of Detection as a Function of Lateral Range

Proper implementation requires imposing course and speed restrictions on the target.

Hold Time

Assumes the presence of a target in the area. Difficult to normalize size and shape of the target OPAREA.

Contact Validity Ratio

Assumes the presence of a submarine in the operating area and is a function of target operating area and target density.

Legacy SHAREM Metrics

Cumulative Probability of Detection

Accounts for target distance regardless of target movement.

Time Expended Tracking Invalid Contacts

Independent of submarine location or size of the target operating area "cost of doing business" concern relatively independent of other factors.

False Contact Rate

Considers invalid contacts only. Submarine location and OPAREA size do not matter.

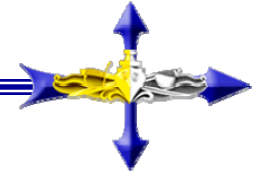
Improved SHAREM Metrics

"An exercise without analysis is, at best, a demonstration..."



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Improved SHAREM Metrics



Find

Detection and Classification

CP_d
 $CP_{d\&c}$
False Contact Rate
Probability of False Contact

Track

Tracking

Percent Time Tracking Invalid Contacts
Ability to maintain track

Fix

Localization

Localization Probability

Target

Engage

Attack Effectiveness

Invalid Attack Rate
Invalid Attack Probability
Valid Attack Probability

Assess

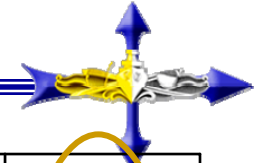
Independent & Defensible Measures



What's Reported – Vice Quoted

Presentation Matters

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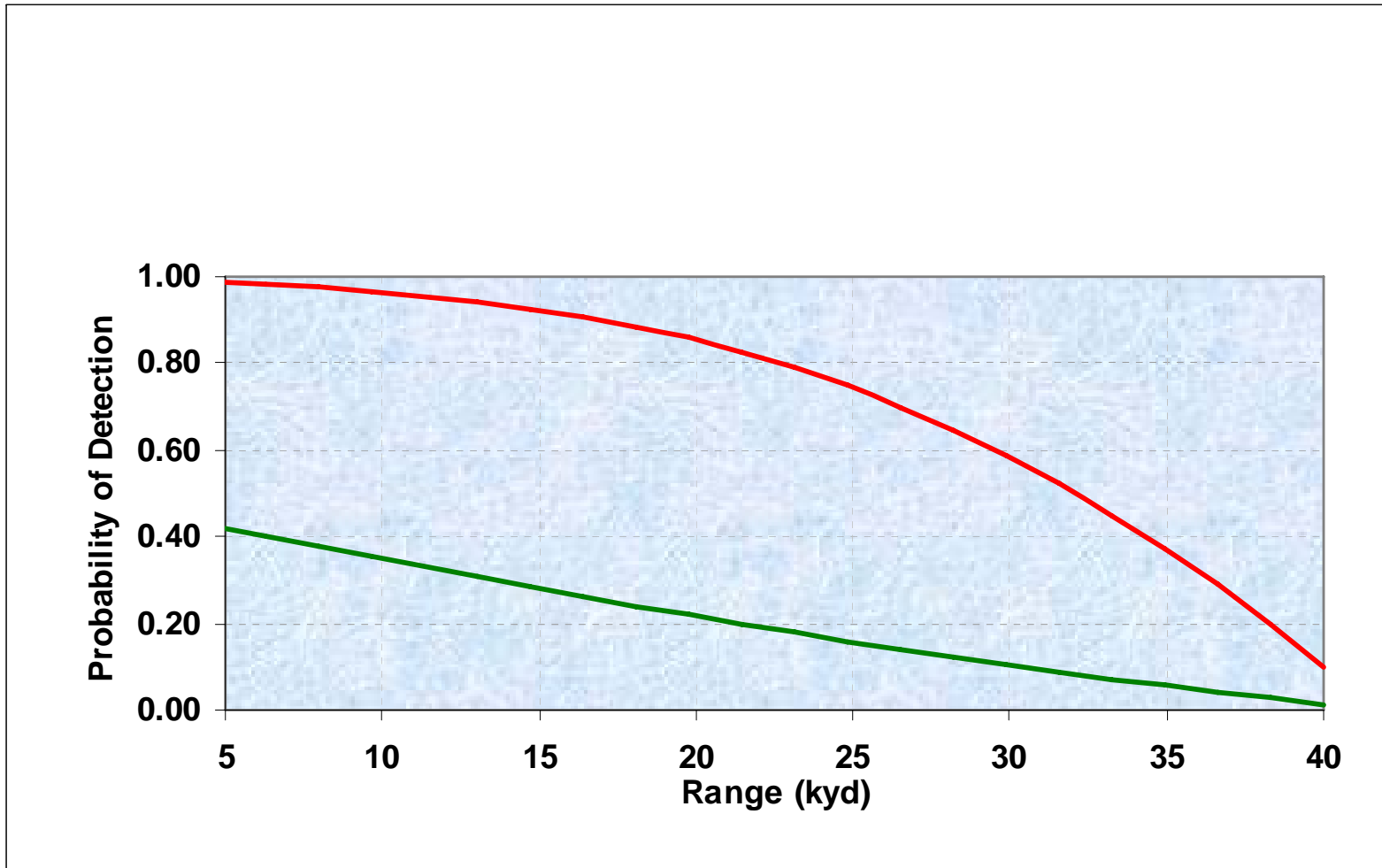
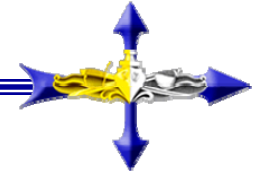
Event	False Alarm	False Alarm per Day	Exp	Det	Det/Exp (%)	Exp Time	Hold Time	Hold/Exp (%)
09100	1	3	84	47	56	3:59:30	3:25:41	86
10400	0	0	2	2	100	4:23:00	3:02:56	70
10900	7	7	32	12	38	6:26:47	5:02:18	78
1			2	1	50	1:02:00	0:26:21	42
2								
12100	0	0	2	2	100	2:23:00	1:55:11	81
12500	0	0	11	9	82	8:50:55	8:44:40	99
12800	0	0	N/A	N/A	N/A	N/A	N/A	N/A
14100	3	4	14	7	50	1:09:48	1:10:16	100
15100	3	2.1	29	9	31	00:49:11	0:09:05	19
Struc	1	0.89	99	60	61	19:36:25	17:08:28	87
F-P	13	4.1	77	29	38	9:26:59	6:48:00	72
Total	14	2.8	176	89	50	29:03:24	23:56:28	82



I-SHAREM

One Exercise – One Day

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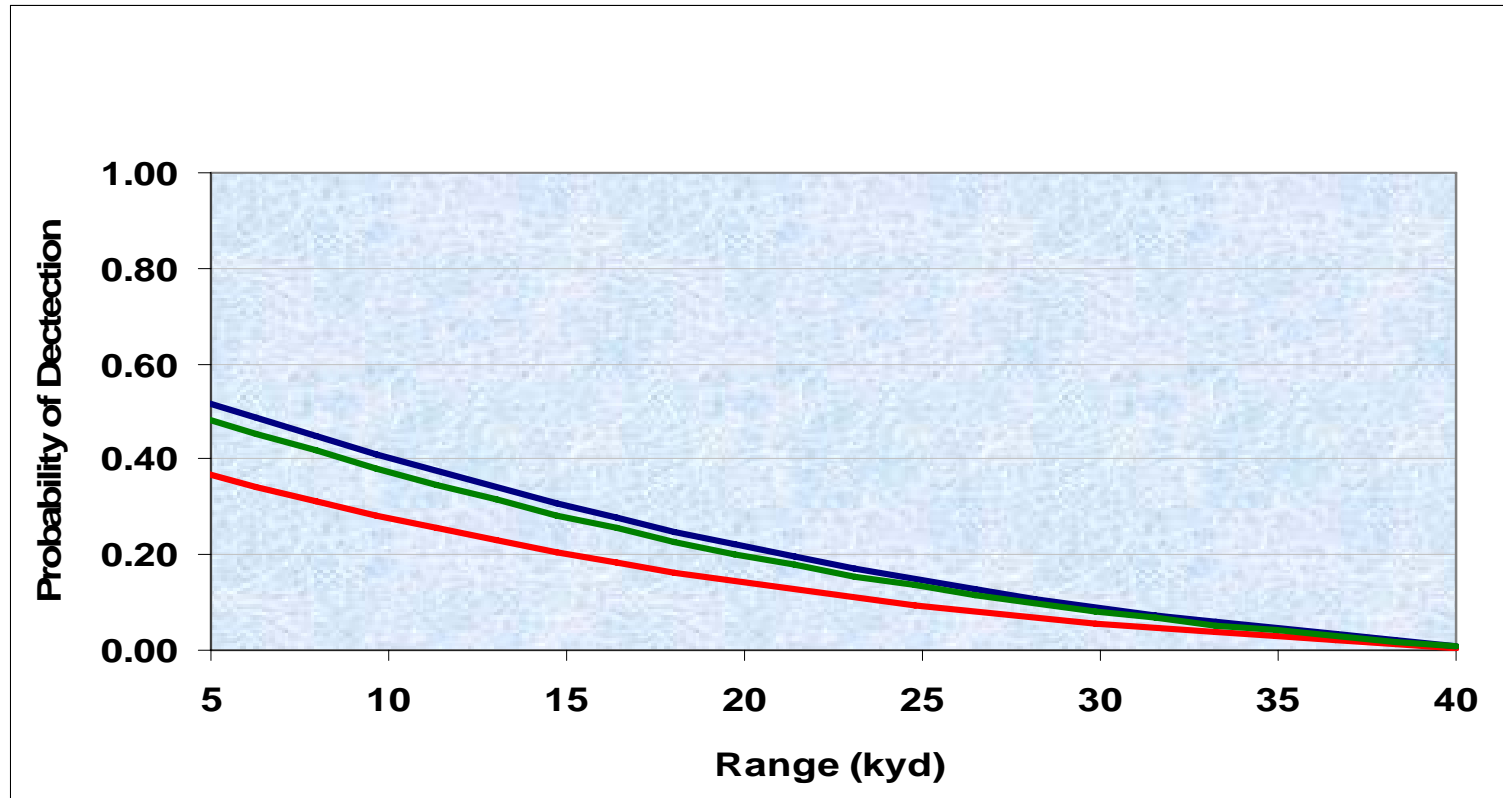
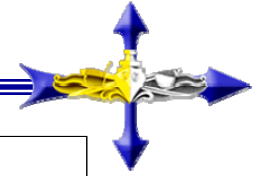




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Same Exercise – Another Day

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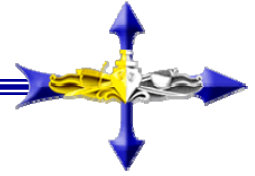
Judging overall performance based on data from one event = Danger!



SHAREM

37 Years of Lessons Learned

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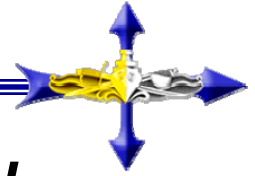
- ✓ ***Background/Overview***
- ✓ ***Improved-SHAREM Process***
- ✓ ***MOEs & MOPs***
- ✦ ***Lessons Learned***



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Lessons Learned

Evolving to Match Environment...



- ***Exercises designed to objectives - Sequence is critical***
 - ☐ *Start with objectives – limit the number or acknowledge failure*
 - ☐ *Develop analysis plan to support objectives*
 - ☐ *Identify data requirements based on objectives and analysis plan*
 - ☐ *Design exercise (experiment) to support objectives*
 - ☐ *Detailed data collection and analysis plan up-front!*
- ***Expanded use of Limited Objective Experiments (LOEs)***
 - ☐ *Smaller scale easier to manage,*
 - ☐ *Better ensures goal attainment*
- ***Trade-offs between exercise and experiment requirements***
 - ☐ *Requires early “buy-in” on priorities by all concerned*
 - ☐ *Prioritization of events to ensure realization of objectives*
 - ☐ *Incorporation of desires requires deconfliction*
- ***SHAREM IPT sets objectives and schedules venues***

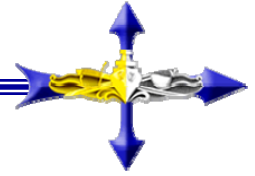
SWDG remains the honest broker for Surface Warfare Capabilities



Lessons Learned

Technologies - Only part of the solution

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- ***Unrealized potential remains when systems are used without complete understanding***
- ***New systems require different thinking & TTP***
 - ❑ *Systems lacking TTP will be sub-optimized*
 - ❑ *New systems may not perform as advertised – but will definitely be sub-optimized without accompanying TTP*
- ***Technology inserts are not silver bullets and may only have niche applications***
 - ❑ *Systems need to be integrated & interoperable*
- ***Improved SHAREM analysis provides comparable answers between disparate technologies***

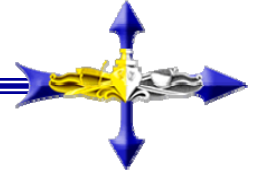
“Any order of magnitude change requires completely new thinking – old methods may no longer be applicable...” – Richard Hamming



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Lessons Learned

Training & Proficiency



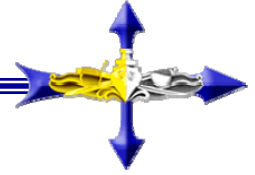
- ***Training provides basics – practice yields proficiency***
- ***Establishing training & proficiency levels key***
 - ❑ *Assesses training/proficiency impact on overall performance*
 - ❑ *Informs training community on knowledge gaps*
 - ❑ *Establishes ‘remedial’ and/or ‘refresh’ training requirements*
 - ❑ *Guides synthetic trainer developments*
 - ❑ *Informs Fleet Response Plan requirements*
- ***Feedback for acquisition and research & development communities***
- ***Consistent & coherent metrics needed***



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Lessons Learned

Metrics



➤ ***Metrics 'musts' :***

- ☐ *Translatable*
- ☐ *Defensible*
- ☐ *Comparable*
- ☐ *Understandable*
- ☐ *Reproducible*
- ☐ *Objective based*
- ☐ *Identify KPPs*
- ☐ *Pass Independence test*

➤ ***Introduction of new metrics will meet resistance***

➤ ***Single point evaluations are suspect***

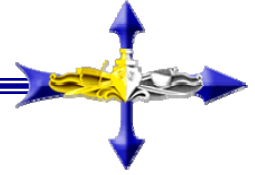
"Not everything that counts can be counted, and not everything that can be counted counts." - Einstein (attributed)



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Lessons Learned

Kitchen sink...



- ***Quicklooks are always inaccurate***
- ***Human factors and memories can skew results***
- ***Piggy-backed evolutions will generally fall short***
- ***True Freeplays yield little insight - often result in “no tests”***
 - ❑ *Freeplays with objective focused instructions can produce insight*
- ***All results scrutinized – especially those contrary to perceptions***
- ***Repeat Lessons Learned are Ongoing Discrepancies!***
- ***Rapid warfighter/participant feedback critical***
 - ❑ *Best practices may only apply to given circumstances*
 - ❑ *Documentation is key to moving forward and not forgetting...*

Questions?





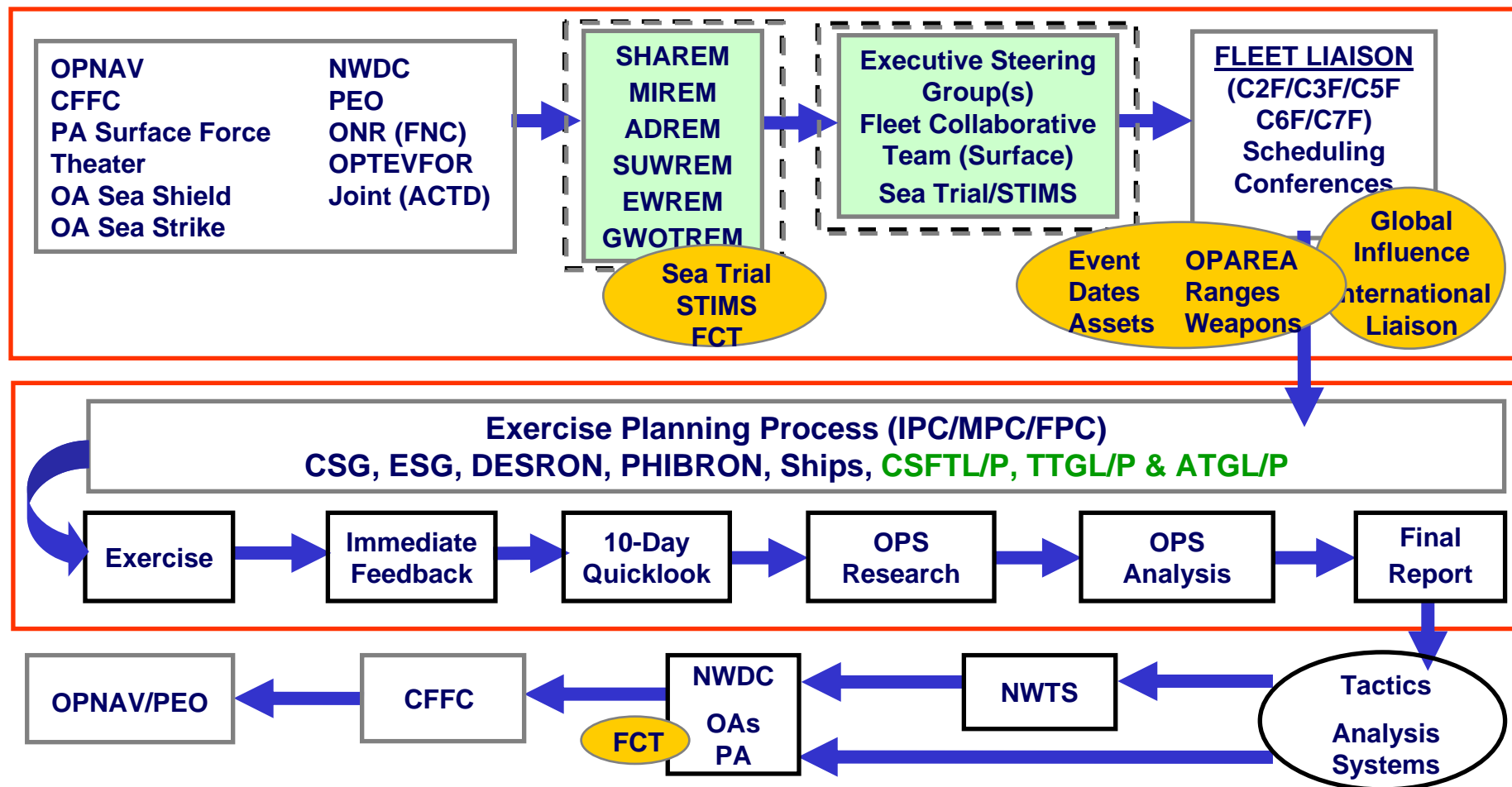
I-SHAREM -> SURFREM

Extension Across All Warfare Areas

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SURFREM ... The Future Of The SHAREM / MIREM Process



Surface Force Programmatic Input... Tactical Development... Analytical Feedback